



Department of Pesticide Regulation



Mary-Ann Warmerdam
Director

MEMORANDUM

Arnold Schwarzenegger
Governor

TO: Barry Cortez, Chief
Registration Branch

FROM: John S. Sanders, Ph.D., Chief (Original signed by)
Environmental Monitoring Branch
(916) 324-4039

DATE: May 27, 2005

SUBJECT: RECOMMENDATION FOR A REEVALUATION AND REGISTRATION
REQUIREMENT TO LIMIT THE VOLATILE ORGANIC COMPOUND
CONTENT OF CERTAIN PESTICIDE PRODUCTS

Overview

The Department of Pesticide Regulation (DPR) is evaluating how best to achieve its goals to reduce volatile organic compound (VOC) emissions from pesticides in nonattainment areas, as outlined in the 1994 State Implementation Plan (SIP) for ozone. Additionally, DPR is seeking viable opportunities to reduce VOC emissions from pesticides to help California meet its challenges under the Clean Air Act.

DPR is pursuing a strategy involving regulatory measures, research and changes in pest management practices to reduce VOC emissions. In pursuing VOC emission reductions, DPR is focusing on efforts that:

- will provide measurable emission reductions, as in changes that can be quantified through the pesticide use report and/or the emission factor of pesticide products.
- are compatible with pest management needs
- avoid unnecessary creation or expansion of regulatory processes
- are achievable and within the resource constraints of DPR

As directed by DPR management, the Environmental Monitoring Branch staff analyzed options to reduce VOC emissions by placing limits on the VOC content (emission potential) of certain pesticide products. The following indicates that significant VOC reductions can be achieved with an emission potential limit. Therefore, the Environmental Monitoring Branch recommends implementing an emission potential limit of 20–25 percent by initiating a reevaluation and establishing a condition of registration for certain liquid pesticide products.



Background

VOCs and nitrogen oxides react with sunlight to create ozone, a major air pollutant. Many pesticide active ingredients as well as inert ingredients are VOCs. The Clean Air Act requires SIPs to reduce the emissions of VOCs and nitrogen oxides in areas that do not meet the ozone standard (nonattainment areas). Under the 1994 SIP, DPR committed to reduce VOC emissions from agricultural and commercial structural applications of pesticides by specified amounts within specified time periods for five nonattainment areas. The nonattainment areas, pesticide VOC reduction goals (relative to 1990 base year), and current status are (also shown in Figure 1):

<u>Nonattainment Area</u>	<u>SIP Goal</u>	<u>SIP Status</u>
• South Coast	20% reduction by 2010	currently meets SIP goal
• Southeast Desert	20% reduction by 2007	currently does not meet SIP goal
• Ventura	20% reduction by 2005	currently does not meet SIP goal
• Sacramento Metro	20% reduction by 2005	currently meets SIP goal
• San Joaquin Valley	12% reduction by 1999	currently does not meet SIP goal

Much of the analysis and options discussed below focus on the San Joaquin Valley nonattainment area because DPR is evaluating options to achieve its 1999 goal. Goals for all other areas will occur in 2005 or later.

Analysis of Emission Inventory Data

Under the 1994 SIP, DPR developed a method to estimate the VOC content (emission potential) of pesticide products and to calculate estimated pesticidal VOC emissions. California has a reporting system for pesticide use, which, in conjunction with the VOC emission potential, allows for an estimate of pesticidal VOC emissions and compilation of an emission inventory. There are a number of uncertainties in DPR's emission inventory that likely cause the pesticide VOC emissions to be overestimated. While actual pesticide VOC emissions may be uncertain, the reduction goals are expressed relative to 1990 baseline emissions. The net effect of uncertainties or biases in the data is reduced when evaluating relative effects of various reduction options or determining trends. DPR's emission inventory is most useful for trend analysis and evaluating reduction options.

Total pesticide VOC emissions in the San Joaquin Valley nonattainment area were 23.2 tons/day for May-October 2002, and 26.5 tons/day for May-October 2003, exceeding the 1999 goal by 2.0 and 5.4 tons/day (Table 1). The 1999 goal of 21.1 tons/day represents a 12 percent decrease from 24.0 tons/day for the 1990 base year. As in previous years, fumigant, chlorpyrifos, and glyphosate products make up most of the San Joaquin Valley emission inventory (Table 1). Products with the

fumigants metam-sodium, 1,3-dichloropropene, and methyl bromide as the primary active ingredients comprise the largest portion of the pesticide VOC emission inventory in the San Joaquin Valley. The fumigant chloropicrin makes up a significant portion of several fumigant products, but is typically present as a secondary active ingredient.

Liquid products, particularly those formulated as emulsifiable concentrates, are the next highest contributors to the pesticide VOC inventory. Pesticide products formulated as liquids comprise approximately 40 percent of the pesticide VOC emission inventory in the San Joaquin Valley nonattainment area (Table 2), with products containing chlorpyrifos and glyphosate accounting for approximately 15 percent of the inventory (Table 1).

As shown in Table 3, pesticides used on carrots and potatoes make up a significant portion of the pesticide VOC inventory, primarily due to their use of fumigants. Pesticides used on cotton, almonds, and oranges make up a significant portion of the pesticide VOC inventory due to use of liquid pesticides, particularly emulsifiable concentrates. The VOC inventory for pesticides used on grapes is due to fumigants as well as liquid pesticides.

Issues and Options to Reduce Pesticide VOC Emissions

It is likely that VOC reductions will continue to be achieved through nonregulatory measures, such as greater adoption of integrated pest management practices. However, to meet the current VOC reduction commitments as well as California's future needs a research and regulatory agenda should be pursued. The Air Resources Board (ARB), the University of California, the U.S. Department of Agriculture, and others are pursuing research to increase the accuracy of the pesticide emission inventory as well as reduce pesticide VOC emissions. However, this research will take several years to complete, and reduction measures should be implemented sooner to achieve the goals of the 1994 SIP.

There are six primary categories of options for reducing pesticide VOC emissions:

- formulation changes
- application method changes
- application rate reductions
- temporal changes
- spatial limits
- integrated pest management

All of the options have advantages and disadvantages. It is likely that no single measure will achieve all of the needed reductions. However, formulation change is one of the few regulatory measures that will likely achieve significant VOC reductions within DPR's constraints:

- measurable emission reductions will primarily occur through changes reported in the pesticide use report and/or in the emission factor of pesticide products.
- compatible with pest management needs
- avoids the unnecessary creation or expansion of regulatory processes
- achievable and within the resource constraints of DPR

Evaluation of Formulation Changes to Reduce Pesticide VOC Emissions

Reformulation of certain pesticide products can achieve VOC reductions. Additionally, this is one of the few regulatory options for which DPR can estimate the reductions with available data. Reformulation is likely a viable alternative only for liquid, nonfumigant pesticides. It is probably not possible or cost-effective to lower the VOC content of pesticides formulated as solids. It is also probably not possible to reformulate fumigant or other pressurized products (Exception: it may be possible to reformulate 1,3-dichloropropene products to eliminate the less efficacious of the two isomers and reduce application rates).

Liquid (nonfumigant) products currently comprise approximately 40 percent of the pesticide VOC emission inventory for the San Joaquin Valley nonattainment area (Table 2). An emission potential limit on liquid pesticide products, analogous to ARB's limits for consumer products (including pesticides), would reduce emissions, assuming all other use factors remain equal. Tables 4–6 show the estimated VOC reductions associated with various emission potential limits for the liquid products. As with all pesticide VOC emission estimates, there are uncertainties due to unknown emissions under field conditions, possible underreporting of pesticide use, and other factors. There are additional uncertainties associated with these VOC reduction estimates due to year-to-year variation in use, and the number of products with unknown (assigned default) emission potentials. These uncertainties have a much greater effect on the absolute VOC estimates (tons/day VOC reduction) in comparison to the relative estimates (percent VOC reduction). Therefore, it's likely that DPR can make significant progress in achieving the SIP commitments through reformulation because the commitments are expressed on relative terms. Tables 4–6 indicate that a 8–16 percent reduction in pesticide VOC emissions for the San Joaquin Valley nonattainment area and a 9–18 percent reduction statewide may be achieved with an emission potential limit of 15–30 percent for liquid products. An emission potential limit of 10–15 percent would likely achieve the SIP goal for the San Joaquin Valley nonattainment area.

Use of alternative formulations appears feasible, at least in some cases, as most of the active ingredients making up the majority of the VOC inventory are available as nonemulsifiable

concentrate products (Table 7). Greater use of low-VOC formulations in place of emulsifiable concentrates may be an alternative to reformulation.

The products potentially subject to reformulation should be very broad to ensure that product substitution does not negate the VOC reductions. For example, limiting reformulation to certain formulations (e.g., emulsifiable concentrates) or certain active ingredients (e.g., chlorpyrifos) may cause increased use and emissions from other formulation types or active ingredients. This may require reformulation of several hundred products, so priority should be given to products for which reformulation will achieve the greatest actual or potential VOC emissions. For example, reformulation of chlorpyrifos products should have higher priority than products with other active ingredients because greater VOC reductions will be achieved.

Requirements for reformulation or restrictions on certain formulations may be complicated. For example, DPR may need to evaluate the toxicity of reformulated products, ensure applications rates are not increased to offset the lower VOC content, and criteria for exemptions are established. To accomplish reformulation, registrants would need to conduct research (e.g., solvent selection, efficacy, acute toxicity, stability, phytotoxicity); gain federal and state regulatory approval; and modify production facilities and processes. These tasks take several years to complete at high cost. Because of the time and cost, it would be advantageous to set the emission potential limit as low as possible so that more than one reformulation is not required if additional VOC reductions are needed at a later date.

The reactivity of active and inert ingredients may also be a factor. In this context, reactivity refers to the ability of a specific chemical to create ozone. The amount of ozone created by different chemicals can vary by several orders of magnitude. ARB has determined the reactivity for many inert ingredients and is funding research to determine the reactivity for several active ingredients that are major contributors to the pesticide VOC emission inventory. DPR may want to give higher priority to those products with active ingredients that are highly reactive. In addition, reformulation using highly reactive inert ingredients should be avoided, even if the overall emission potential is reduced. Conversely, this may afford the opportunity to achieve VOC reductions by reformulating with a less reactive inert ingredient even if the overall emission potential is not reduced. However, accounting for reactivity is not possible using DPR's current method for estimating the emission inventory. Straightforward, but time-consuming modifications to the emission potential database or a new database would be needed to account for reactivity.

Recommendations for Reformulation Requirements

DPR should consider pursuing a regulatory measure to mandate the reformulation of certain liquid pesticide products. Products included in the regulatory measure would be subject to a specified emission potential limit. DPR should also consider requiring a specified emission potential limit for certain liquid pesticide products as a condition of registration.

These regulatory actions should include all agricultural and commercial structural-use pesticide products that are formulated as liquids and actively registered with DPR or products that will be registered in the future. Liquid pesticide products that meet any of the following criteria should be exempted from these regulatory actions:

1. Fumigants containing the active ingredients 1,3-dichloropropene, chloropicrin, metam-sodium, methyl bromide, methyl isothiocyanate, potassium N-methyldithiocarbamate, propylene oxide, and sodium tetrathiocarbonate because it is unlikely such products can be reformulated to lower the VOC emission potential. Similarly, acrolein products cannot be reformulated to reduce emissions.
2. Products containing the active ingredients sodium chlorate, sodium hypochlorite, or sulfuric fluoride, because they contain no or negligible amounts of organic compounds.
3. Products with a thermogravimetric analysis value of no more than the specified emission potential limit, or a water/inorganic subtraction value of no more than the specified emission potential limit. The specified limit should be 20–25 percent, depending on the VOC reductions desired.
4. Products containing the active ingredients fenamiphos or molinate, because they are being phased out.
5. Products intended for use as spray adjuvants, because they are not included in the inventory and likely contribute a negligible amount of VOCs.
6. Technical products (intended for use in the manufacture of other pesticide products) because they are accounted for in the end-use products.

The following additional products should be exempted from the reevaluation:

7. Products having a “registration number” (consisting of Manufacturer/Company Firm Number-Product Label Sequence Number) for which the sum of all reported applications of products with that registration number is less than 100 pounds in the 2003 statewide VOC inventory. This includes all products with the same “registration number” that are related by being either additional brand names or distributor registrations (subregistrations). The formulations of additional brand names and distributor registrations are assumed not to differ in any substantive way. These products contribute a negligible amount of VOCs.

It’s likely that other active ingredients or products should be exempted based on the criteria above. For example, other products may contain no organic compounds (exemption #2 above), but do not contain sodium chlorate, sodium hypochlorite, or sulfuric fluoride as the active ingredient. These should also be exempted when requested by the registrant.

The list of pesticide products included in this regulatory action differs somewhat from the list of products included in the previous VOC data call-in reevaluation (California Notice 05–03, dated February 16, 2005). The goal of the earlier reevaluation was to obtain data to better estimate VOC emissions from pesticide products. The goal of this action is to reduce VOC emissions from pesticide products. It’s likely that numerous products with default emission potential values can be exempted under #3 above, once the data requested under Notice 05–03 is received or alternative information is provided that clearly demonstrates that the emission potential meets the specified limit.

An emission potential limit of 20–25 percent is recommended for several reasons. First, these limits will come near or achieve the SIP goal for the San Joaquin Valley nonattainment area. Second, one or two chlorpyrifos products meet these limits, suggesting that other chlorpyrifos products can be reformulated. Since chlorpyrifos products are the largest nonfumigant VOC contributors in the San Joaquin Valley, their reformulation would achieve significant VOC reductions. Third, these limits are comparable to the limits established by ARB for pesticide consumer products. This also suggests that reformulation to these levels is achievable and provides some regulatory consistency.

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If these criteria are used, 750–800 products will be included in a reevaluation (Table 6). Implementing and managing the reevaluation for this many products may take several years with current staff. Priority should be given to the following products:

- reformulation will achieve significant VOC reductions
- contain reactive VOCs
- are applied to foliage
- reformulation will probably not significantly impact efficacy, health, or the environment
- will significantly increase VOCs if used as an alternative for reformulated products

Please contact Randy Segawa, of my staff, if you have any questions regarding this recommendation.

cc: Paul Gosselin, DPR Chief Deputy
Polly Frenkel, DPR Chief Counsel
Tobi L. Jones, Ph.D., DPR Assistant Director
Douglas Y. Okumura, DPR Assistant Director
Randy Segawa, DPR Senior Environmental Research Scientist
Ann Prichard, DPR Senior Environmental Research Scientist
Frank Spurlock, DPR Senior Environmental Research Scientist

bcc: Segawa Surname File

Figure 1. Pesticide VOC emissions during May–October (ozone season) 1990–2003, by nonattainment area. The 1994 SIP commitment and attainment date are shown with the solid horizontal line.

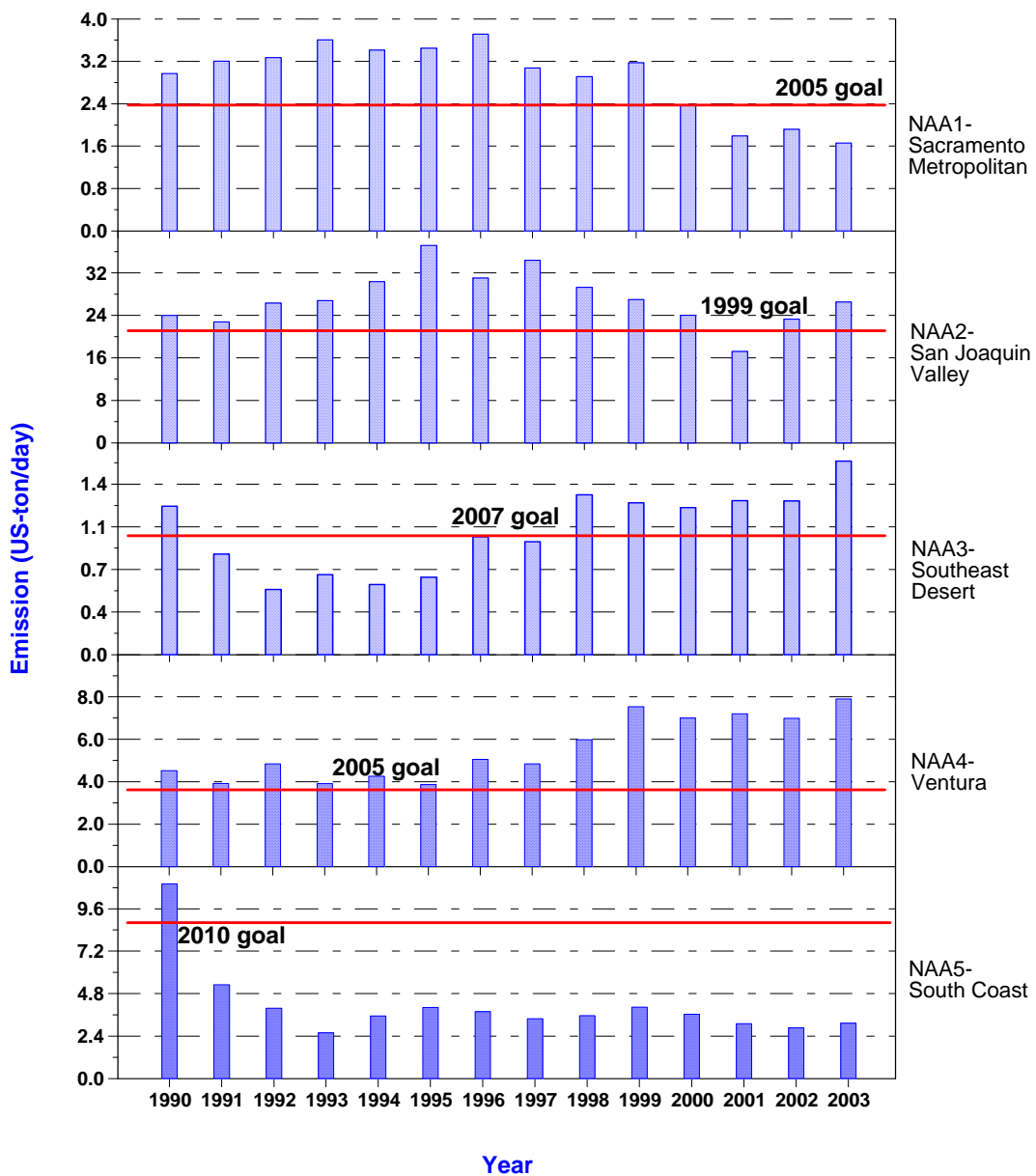


Table 1. VOC emissions from pesticide products by primary active ingredient, San Joaquin Valley nonattainment area, May–October. The primary active ingredient is defined as the pesticidal active ingredient present at the highest percentage in a product.

Primary Active Ingredient	Total Product VOC Emissions (tons/day)	
	2002	2003
METAM-SODIUM	6.23	5.81
1,3-DICHLOROPROPENE	3.30	4.10
METHYL BROMIDE	1.48	2.86
CHLORPYRIFOS	1.97	2.31
GLYPHOSATE, ISOPROPYLAMINE SALT	1.48	1.60
POTASSIUM N-METHYLDITHIOCARBAMATE	0.45	1.01
ACROLEIN	0.54	0.56
DIMETHOATE	0.40	0.49
TRIFLURALIN	0.37	0.46
SULFUR*	0.51	0.45
ENDOSULFAN	0.37	0.33
GIBBERELLINS	0.37	0.34
All Other Active Ingredients	5.41	6.20
Total	23.2	26.5

* VOC emissions from sulfur products are due to the inert ingredients in some formulations.

Table 2. VOC emissions from pesticide products by type of product, San Joaquin Valley nonattainment area, May–October.

Pesticide Type	VOC Emissions (tons/day)	
	2002	2003
FUMIGANT	11.2	13.5
NON-FUMIGANT		
EMULSIFIABLE CONCENTRATE	8.5	9.1
OTHER LIQUID	1.6	1.6
SOLID	1.1	1.0
PRESSURIZED	0.8	1.0
Total	23.2	26.5

Table 3. VOC emissions from pesticide products by commodity or site, San Joaquin Valley nonattainment area, May–October 2002.

Application Site	Fumigant VOC Emissions (tons/day)	Emulsifiable Concentrate VOC Emissions (tons/day)	Total Pesticide VOC Emissions (tons/day)	% of Pesticide VOC Emissions
CARROTS	4.39	0.03	4.44	19.2
COTTON	0.01	2.64	3.08	13.3
ALMOND	0.44	1.18	1.78	7.7
GRAPES	0.30	0.56	1.42	6.1
POTATO	1.09	0.03	1.33	5.8
ORANGE	0.01	0.98	1.21	5.2
RIGHTS OF WAY	0.04	0.17	0.77	3.3
NURSERY OUTDOOR	0.70	0.02	0.73	3.2
ALFALFA	0.00	0.51	0.60	2.6
ONION	0.57	0.01	0.59	2.5
All Other Sites	3.64	2.33	7.22	31.1
Total	11.19	8.47	23.16	100.0

Table 4. Effect of various emission potential limits for liquid pesticide products, San Joaquin Valley nonattainment area, May–October 2003. The 1994 SIP commitment is currently estimated as 21.1 tons/day.

Emission Potential Limit Scenario	Projected Pesticide VOC Emissions (tons/day)	Projected Pesticide VOC Emission Reduction (tons/day)	Projected Pesticide VOC Emission Reduction (%)
Current	26.5	---	---
30% EP Limit	24.4	2.1	8.1
25% EP Limit	23.7	2.9	10.8
20% EP Limit	22.9	3.6	13.6
15% EP Limit	22.1	4.4	16.6

Table 5. Effect of various emission potential limits for liquid pesticide products, San Joaquin Valley nonattainment area, January–December 2003.

Emission Potential Limit Scenario	Projected Pesticide VOC Emissions (tons/day)	Projected Pesticide VOC Emission Reduction (tons/day)	Projected Pesticide VOC Emission Reduction (%)
Current	54.2	---	---
30% EP Limit	50.7	3.4	6.3
25% EP Limit	49.5	4.7	8.6
20% EP Limit	48.2	5.9	11.0
15% EP Limit	46.9	7.3	13.4

Table 6. Effect of various emission potential limits for liquid pesticide products, statewide, January–December 2003.

Emission Potential Limit Scenario	Projected Pesticide VOC Emissions (tons/day)	Projected Pesticide VOC Emissions Reduction (tons/day)	Projected Pesticide VOC Emissions Reduction (%)	Number of Products Affected
Current	60.6	---	---	
30% EP Limit	54.9	5.6	9.3	756
25% EP Limit	53.3	7.3	12.0	763
20% EP Limit	51.6	8.9	14.8	771
15% EP Limit	49.9	10.7	17.7	783

Table 7. Number of products by formulation group for active ingredients with the highest VOC emissions from liquid products, San Joaquin Valley nonattainment area, May–October 2002.

Active Ingredient	# of Emulsifiable Concentrate Products	# of Water-Based Products	# of Solid Products
CHLORPYRIFOS	30	7	28
GLYPHOSATE, ISOPROPYLAMINE SALT ^a	18	42	1
GIBBERELLINS	1 ^b	4	10
ENDOSULFAN	11	0	7
DIMETHOATE	25	2	10
TRIFLURALIN	20	0	17

^a The isopropylamine salt is the highest use form of glyphosate, but two other forms are also used. Additional products contain the other forms.

^b Several gibberellin flowable concentrate products have emission potentials of 92 percent to 96 percent.